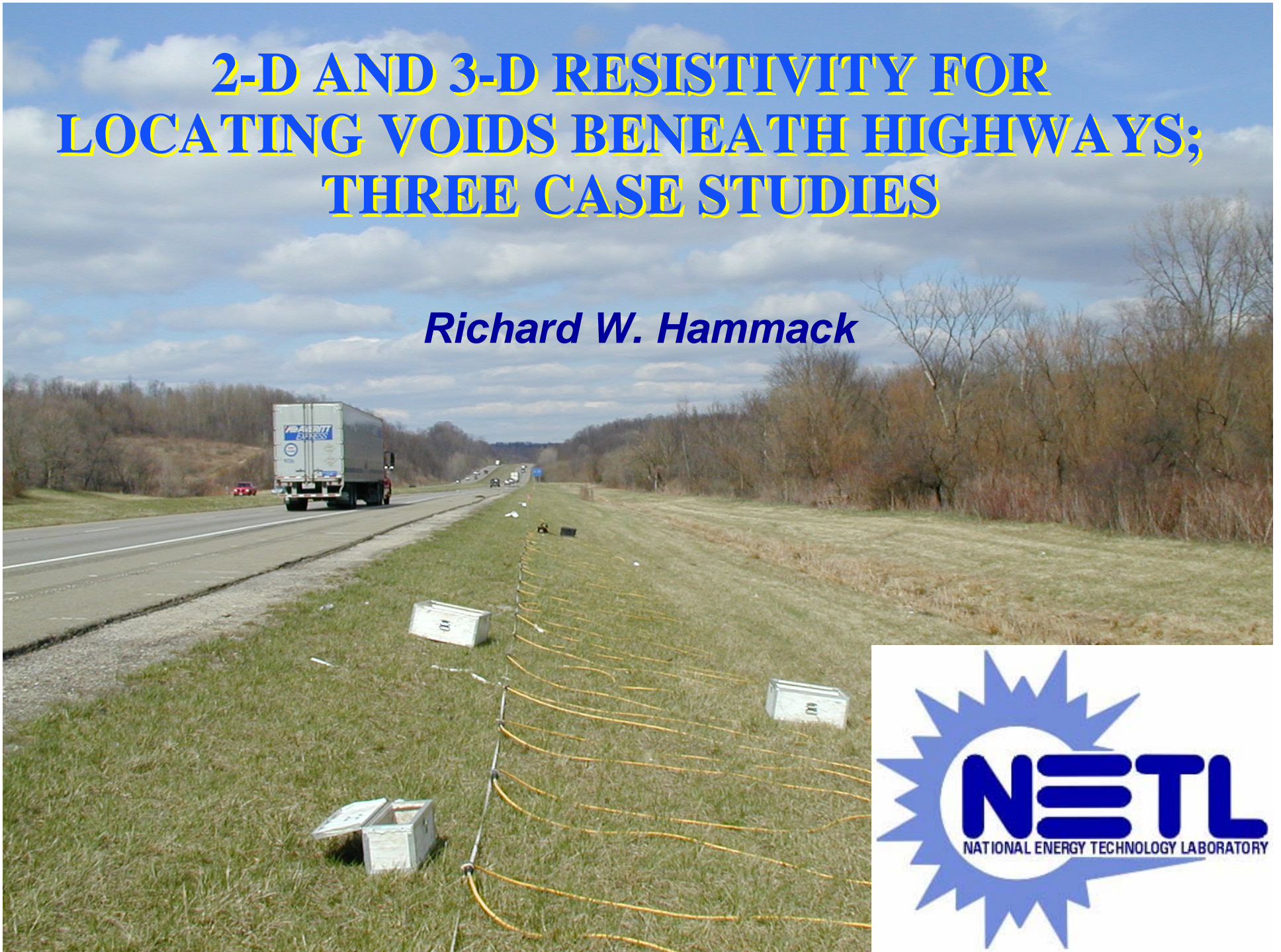


# 2-D AND 3-D RESISTIVITY FOR LOCATING VOIDS BENEATH HIGHWAYS; THREE CASE STUDIES

*Richard W. Hammack*



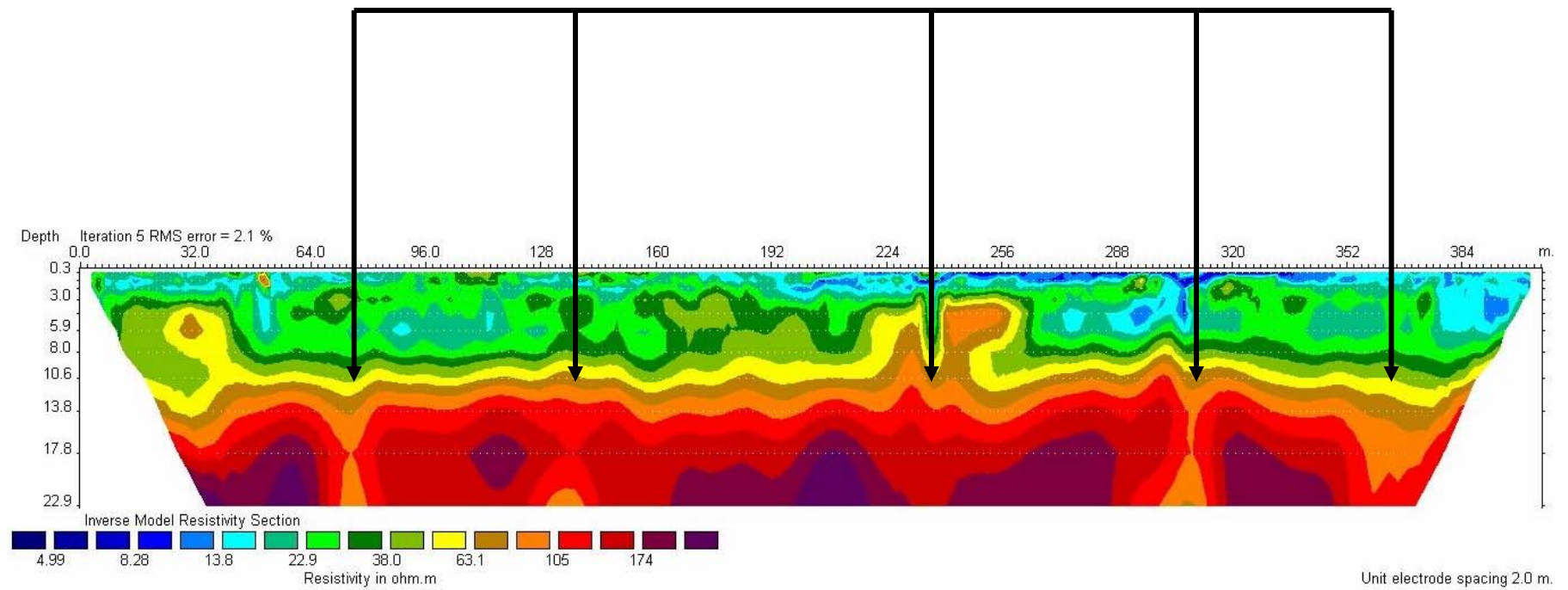


# Interstate 70, Cambridge, Ohio





# Subsidence Zones



# Westminster, MD

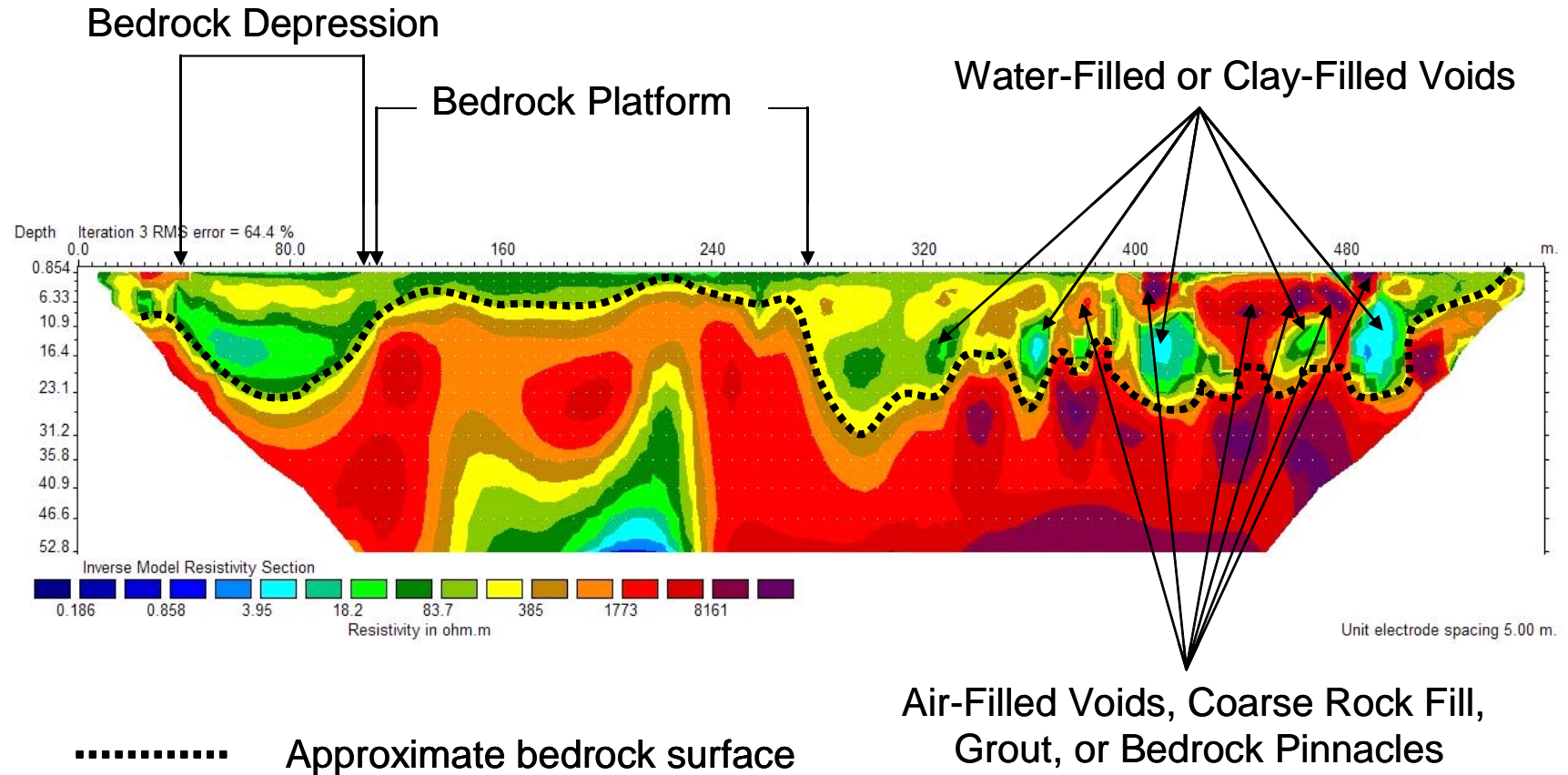


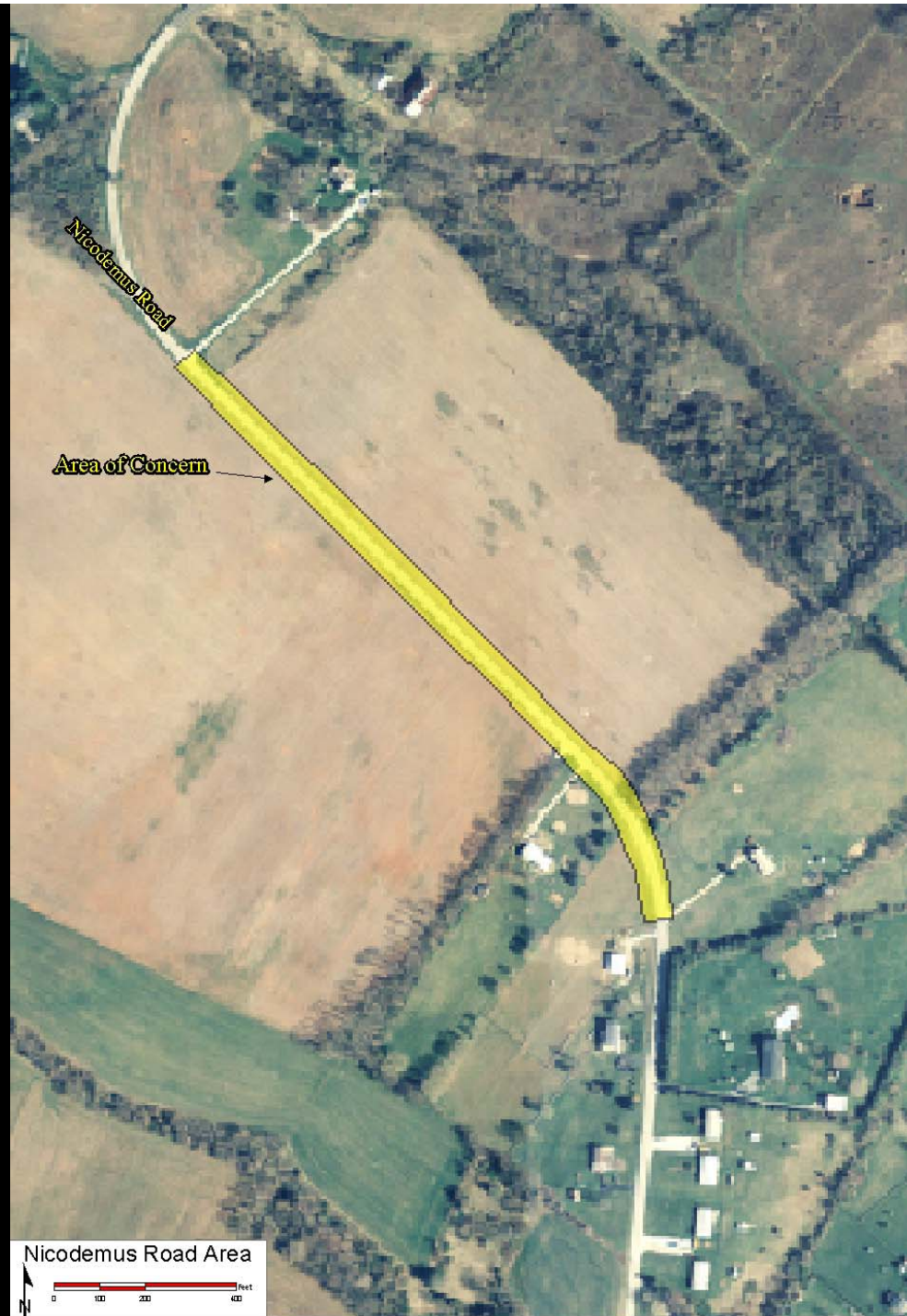






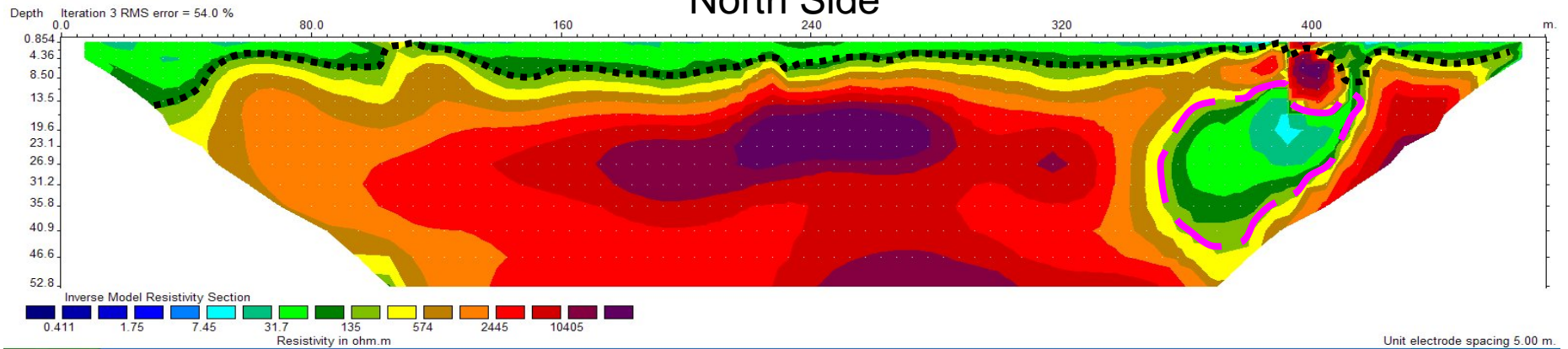
# Medford Road, Carroll County, MD



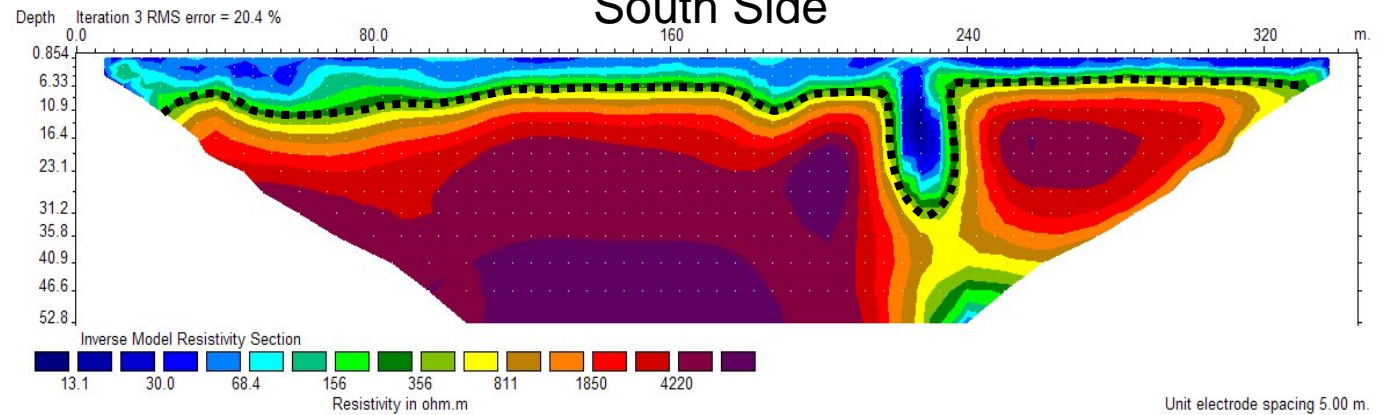


# Nicodemus Road, Carroll County, MD

## North Side



## South Side



- Water- or Clay-Filled Void
- ..... Approximate Bedrock Surface



# Limestone Quarry, Lancaster, PA







Creek bank 3-31-00 and approximate location of holes in bank





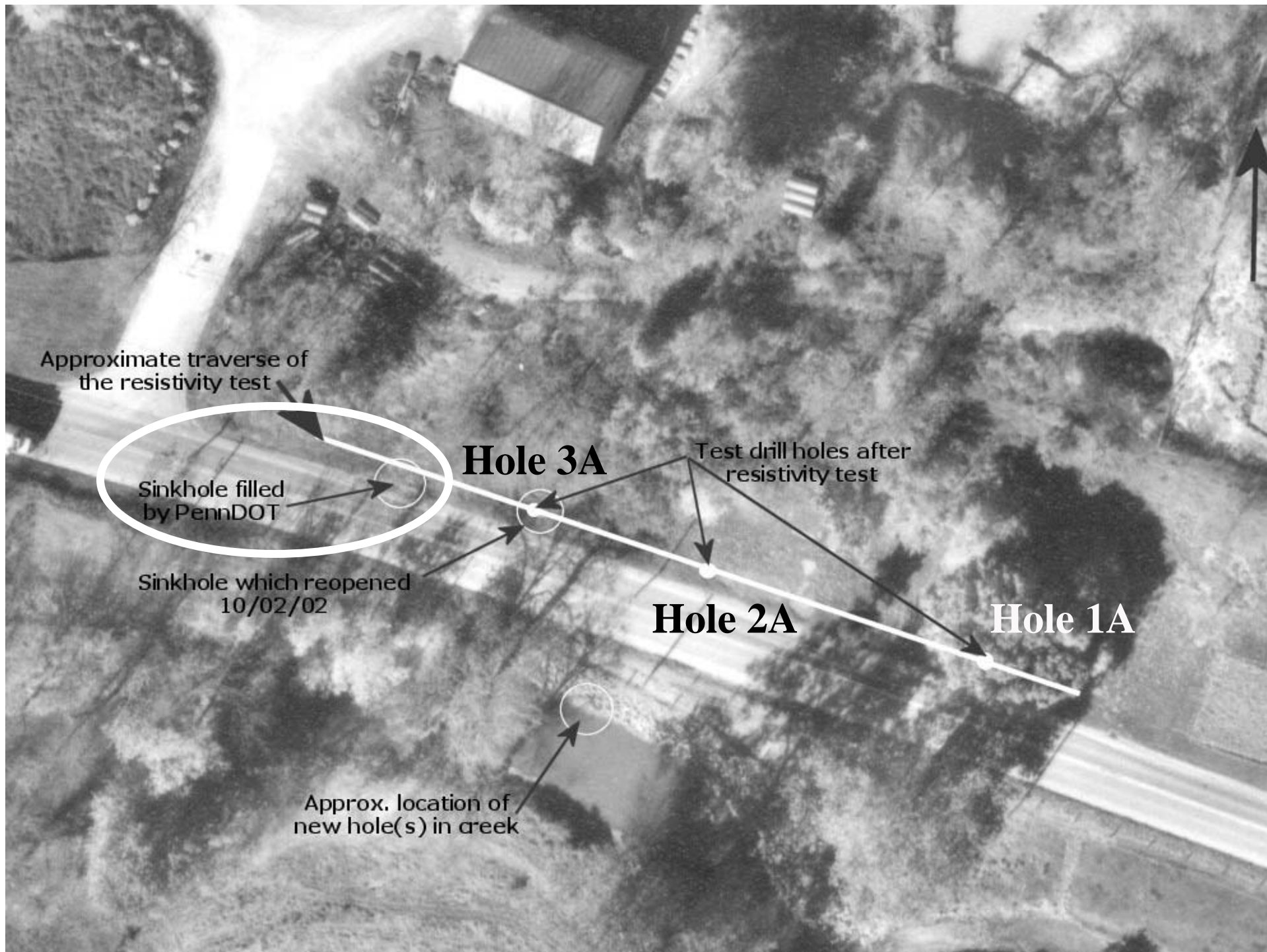
Waterfall 5-3-00





PennDOT filled sinkhole at edge of road





Approximate traverse of  
the resistivity test

Sinkhole filled  
by PennDOT

Sinkhole which reopened  
10/02/02

Approx. location of  
new hole(s) in creek

**Hole 3A**

Test drill holes after  
resistivity test

**Hole 2A**

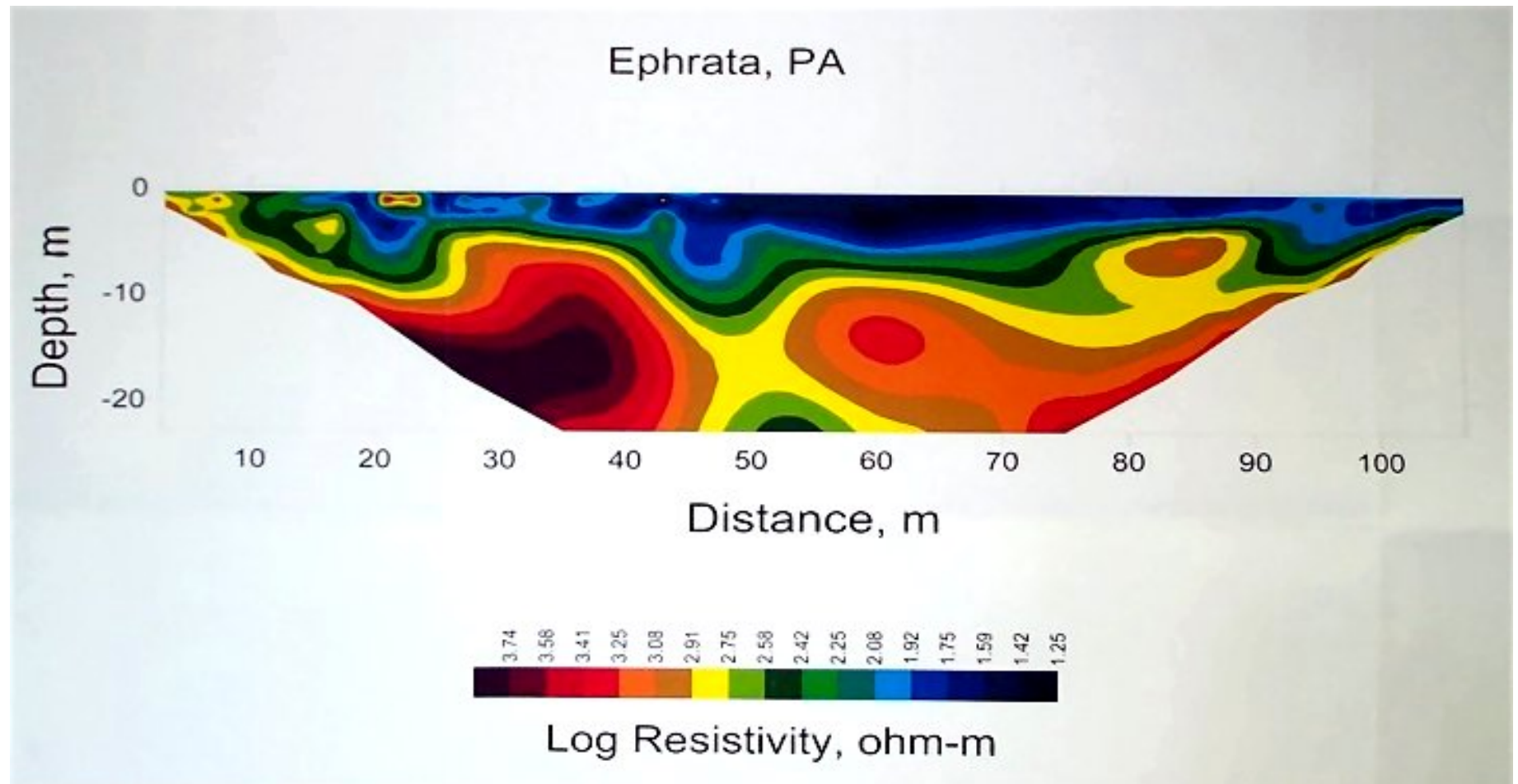
**Hole 1A**





Looking east on Martindale Road: resistivity line shown by red flags. Dirt area is where sinkhole reopened.

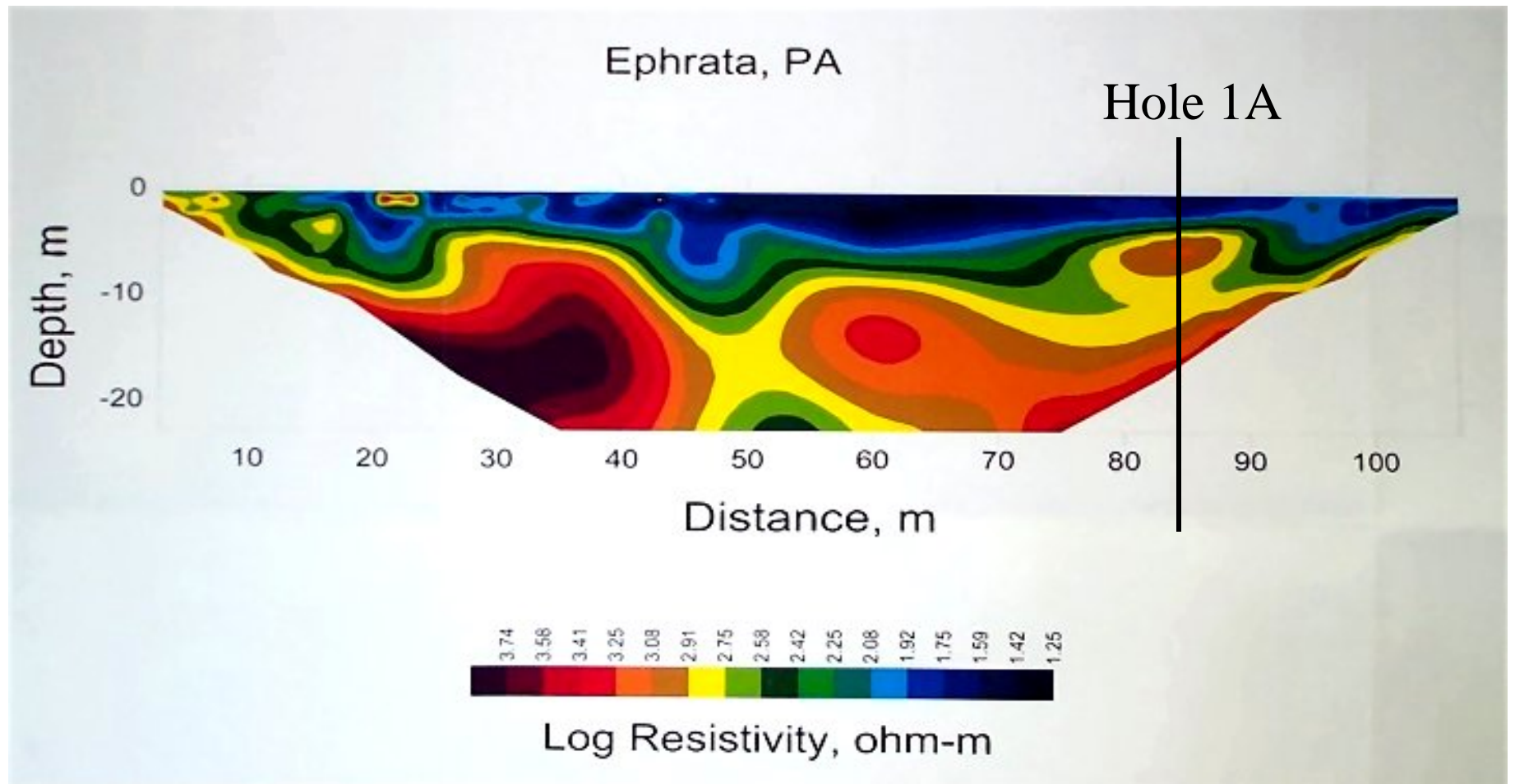




### Resistivity test results – July 2002

Results show traverse line running west to east (left to right). Drilled test holes 9-17-02 along the traverse line at about 35 m, 61 m, and 85 m mark to investigate potential void areas (shown by darker red areas).

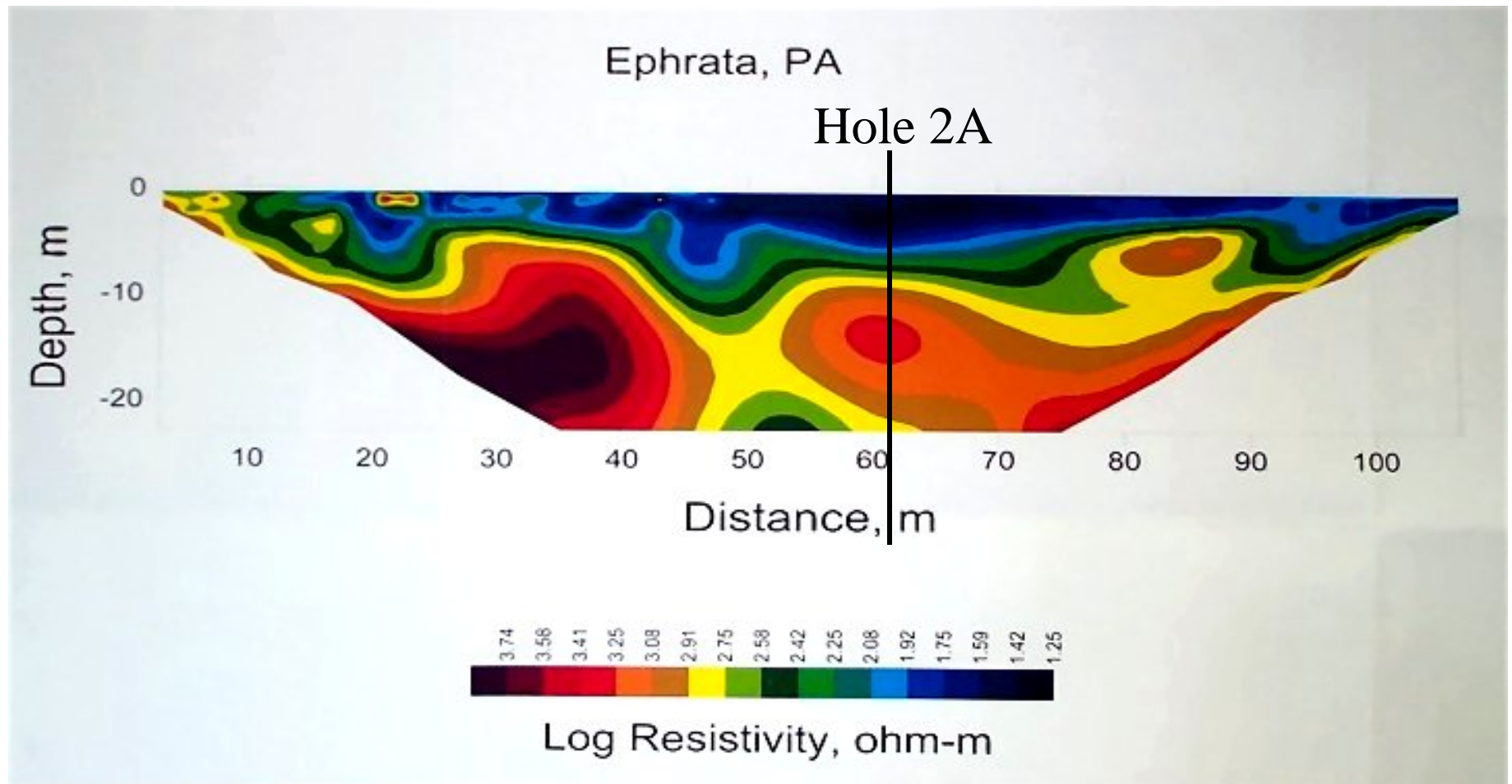




**Hole 1A log – drilled at about 85 m mark (easternmost hole) (Sept 2002)**

0-9	dirt
9-53	rock (hit water between 34' and 37')
53-54	loose seam
54-60	rock

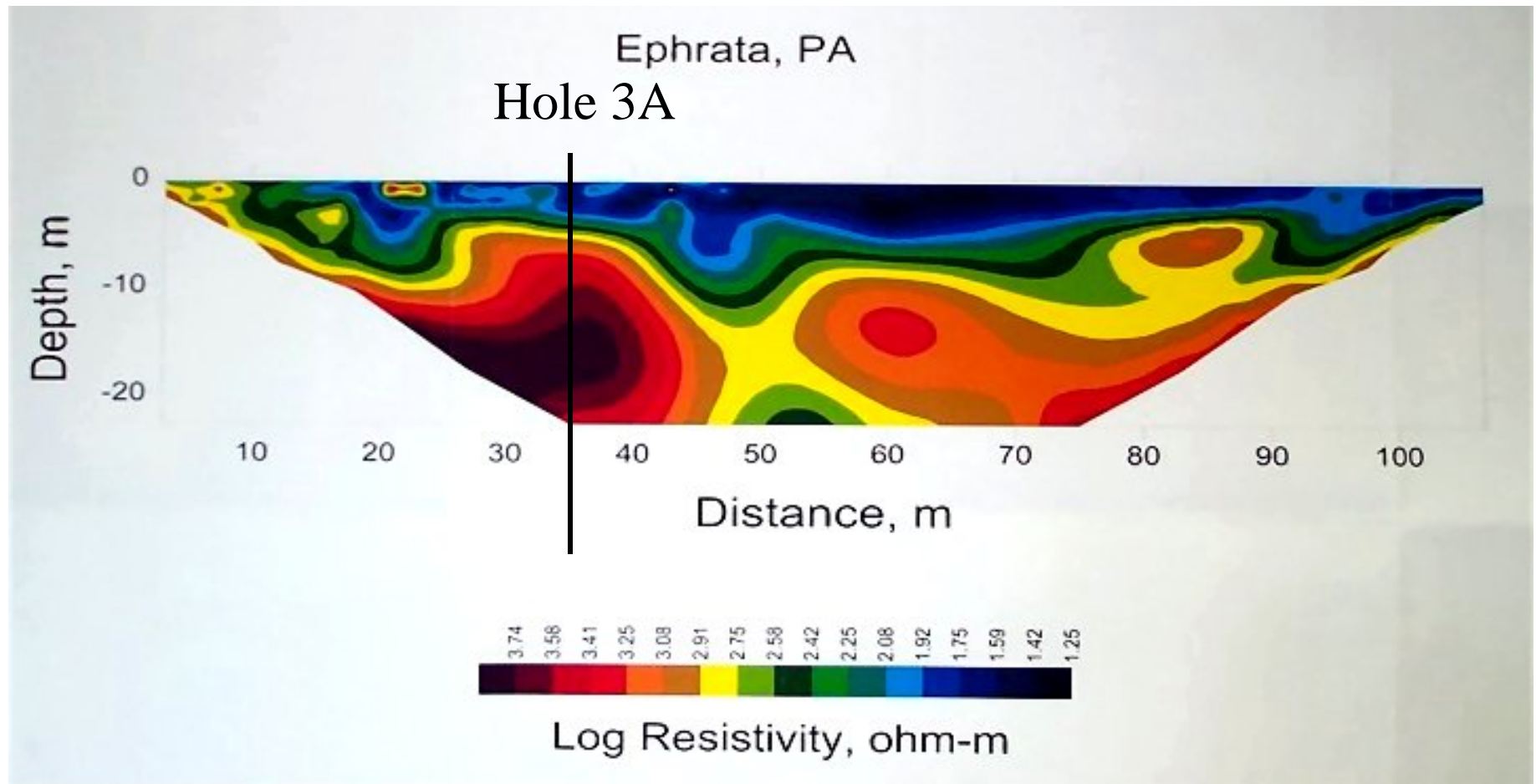




**Hole 2A log – drilled at about 61 m mark (Sept 2002)**

- 0-24 clay and seams
- 24-53 loose rock and mud (water at about 24')
- 53-55 loose seam
- 55-60 rock

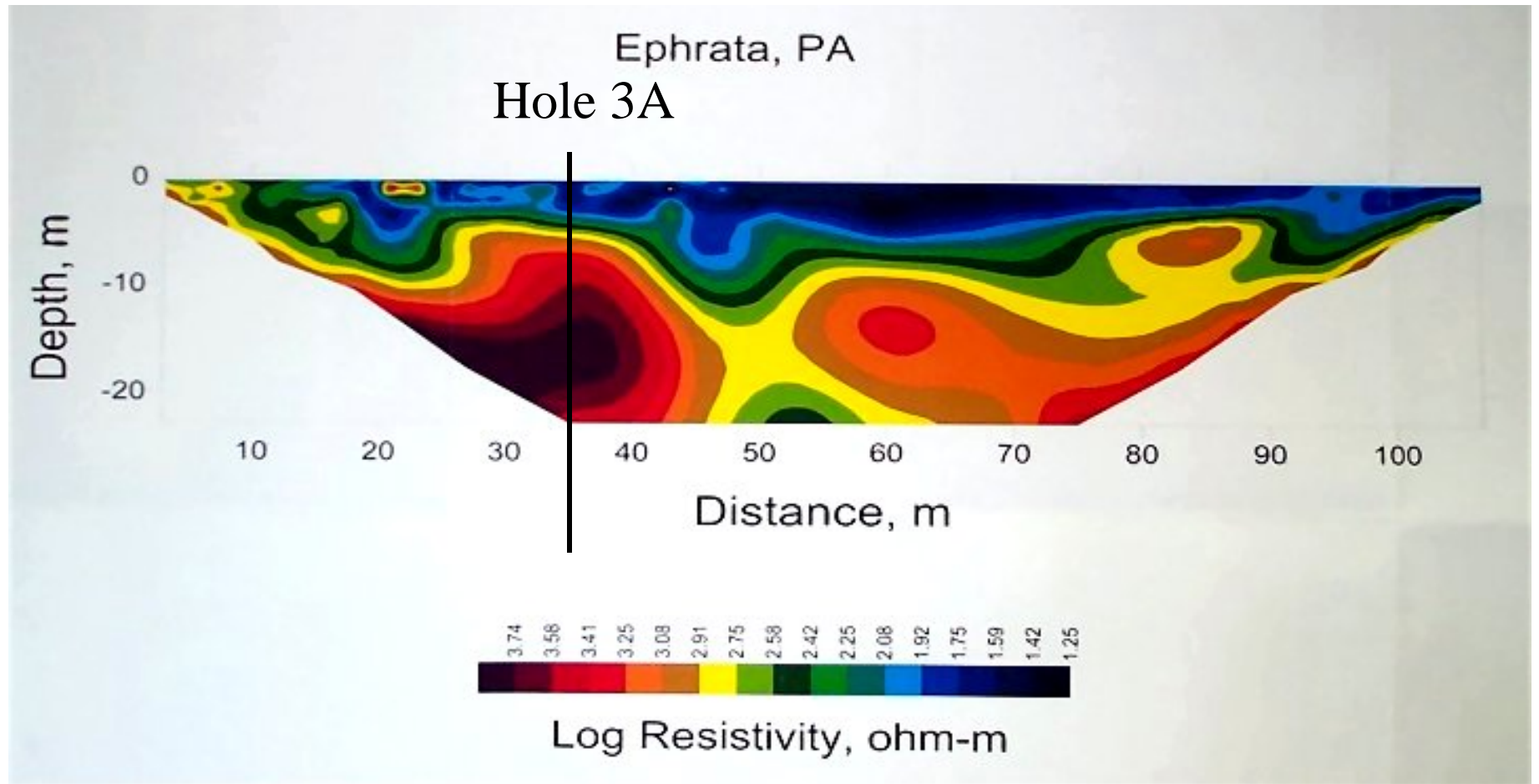




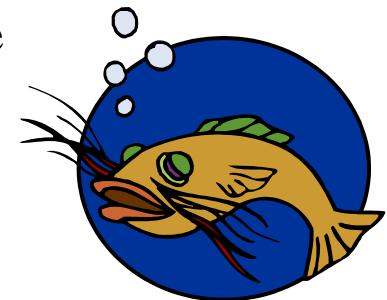
**Hole 3A log – drilled at about 35 m mark (westernmost hole) (Sept 2002)**

- 0-12 clay
- 12-22 rock (hit water at 22')
- 22-47 nothing – drill bit moved through this area very easily.
- 47-60 rock

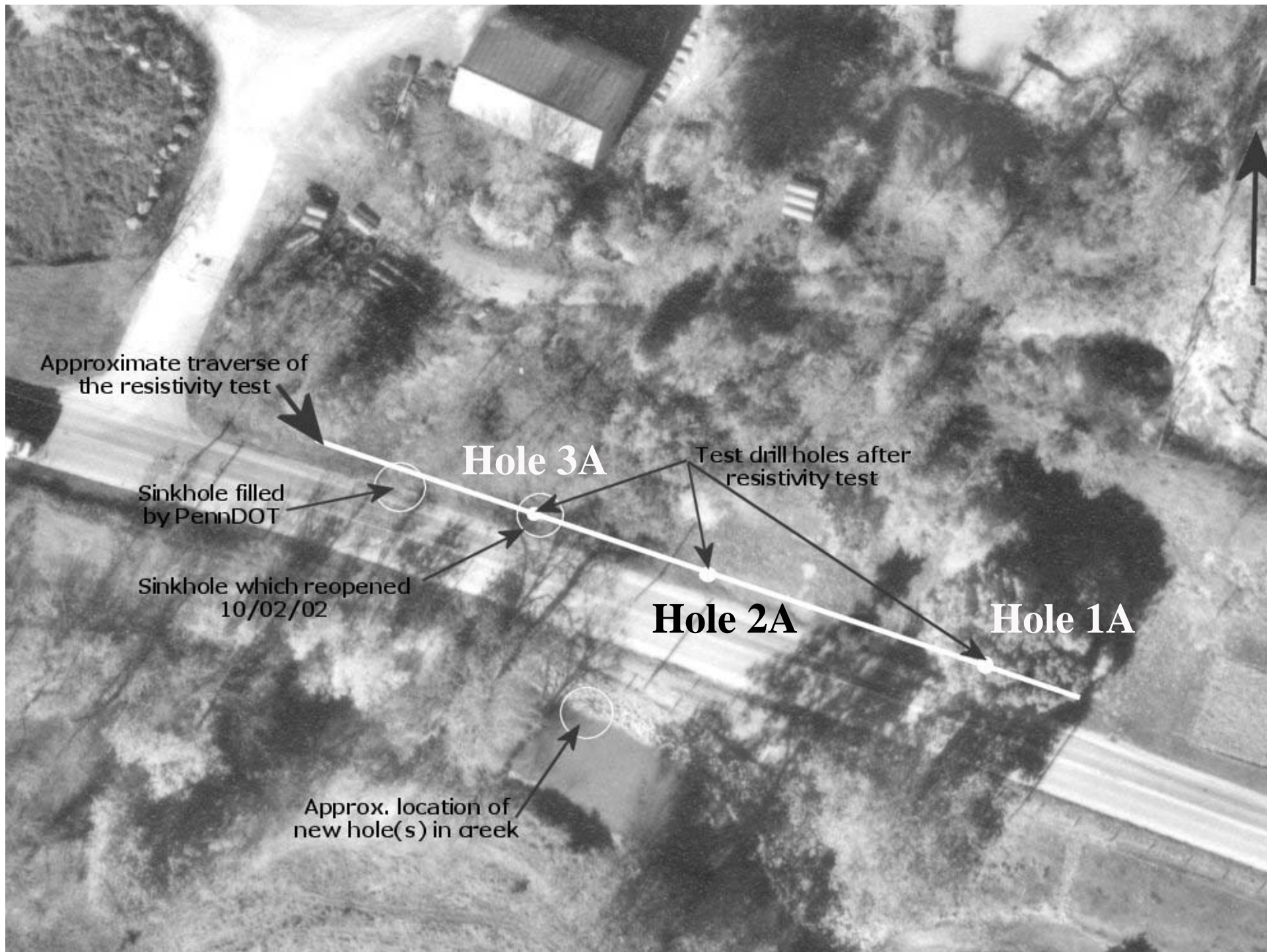




While drilling this hole, the driller spotted a small (~3") catfish laying in the mud around the hole. The fish had apparently been “blown out” of the hole during drilling. After completing the hole, a second small catfish was found next to the hole.







Approximate traverse of  
the resistivity test

**Hole 3A**

Test drill holes after  
resistivity test

Sinkhole filled  
by PennDOT

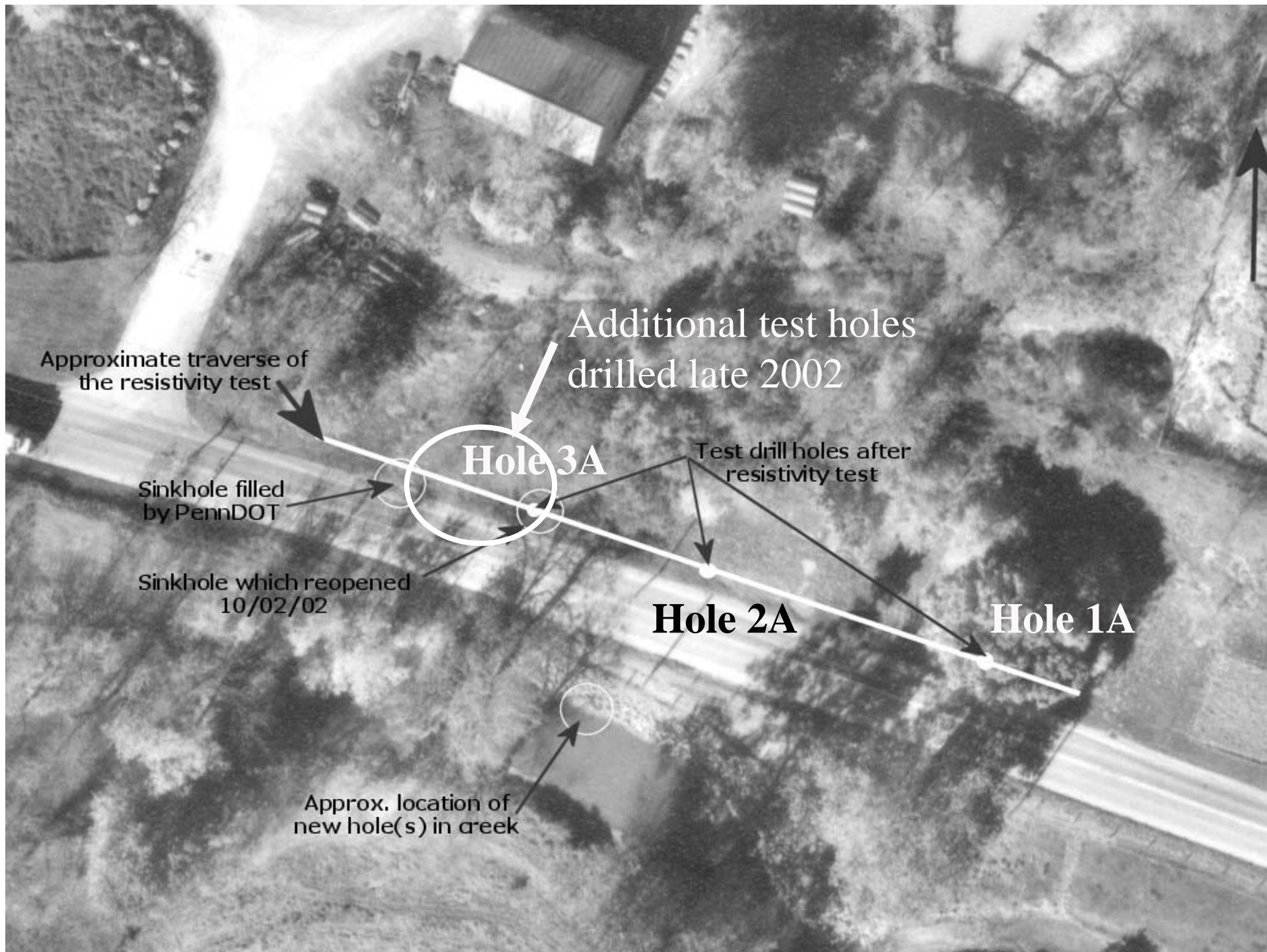
Sinkhole which reopened  
10/02/02

**Hole 2A**

**Hole 1A**

Approx. location of  
new hole(s) in creek





Approximate traverse of  
the resistivity test

Additional test holes  
drilled late 2002

**Hole 3A**

Test drill holes after  
resistivity test

Sinkhole filled  
by PennDOT

Sinkhole which reopened  
10/02/02

**Hole 2A**

**Hole 1A**

Approx. location of  
new hole(s) in creek



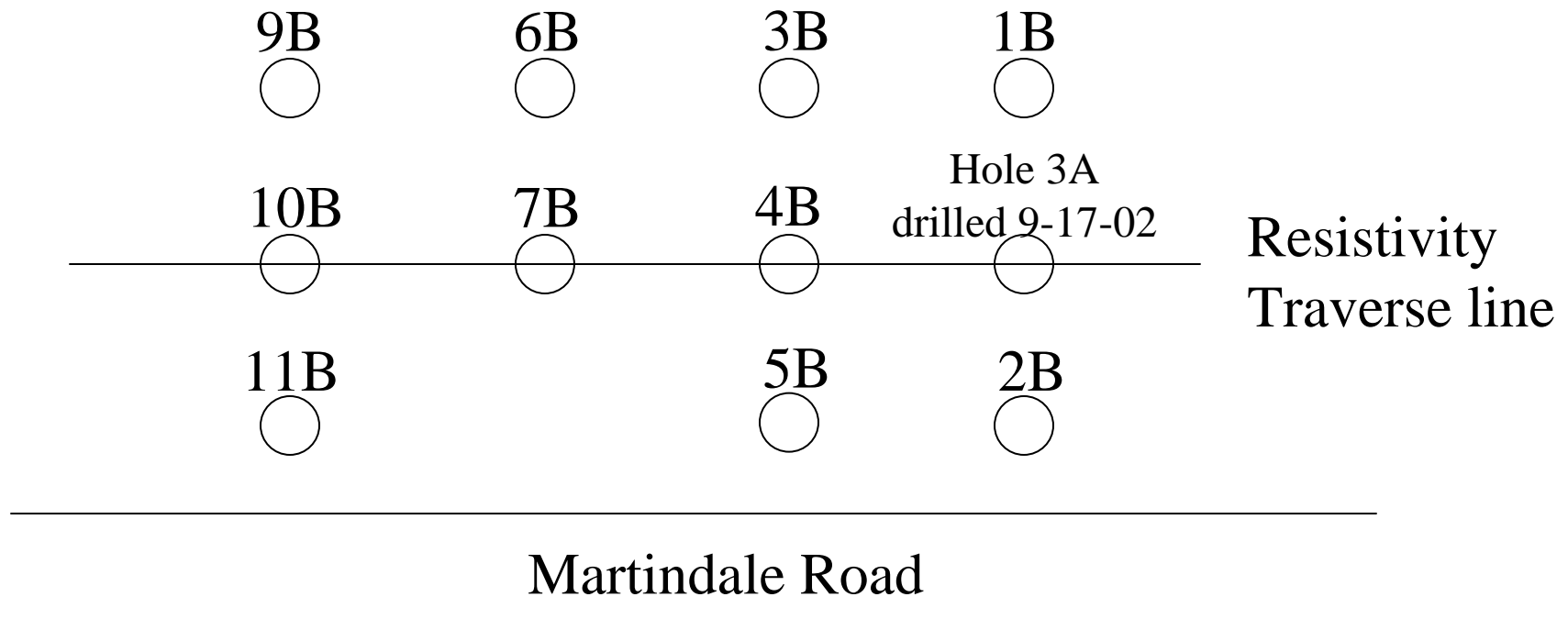


Additional test holes  
drilled in this area.  
Logs on next slide.

Looking east on Martindale Road: resistivity line shown by red flags.  
Dirt area is where sinkhole reopened. (August 2002)



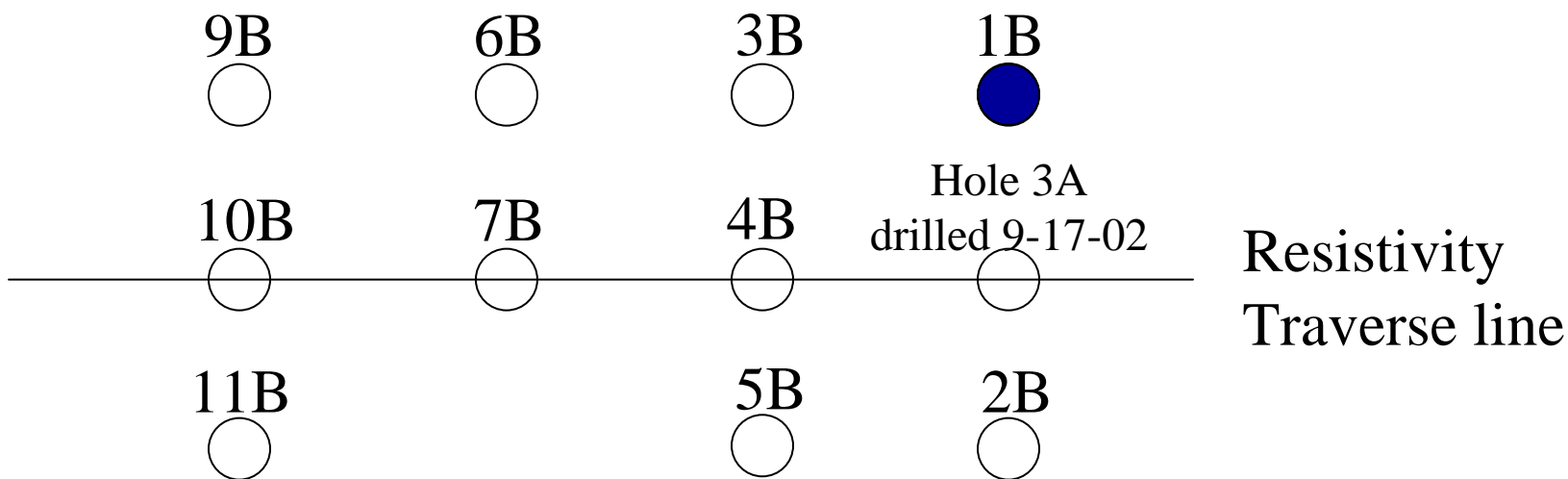
Holes drilled in late 2002 as further investigation on size of potential void on west end of the resistivity test.





**Hole 1B – 60’ deep**

0-25      clay  
25-58    open  
58-60    solid



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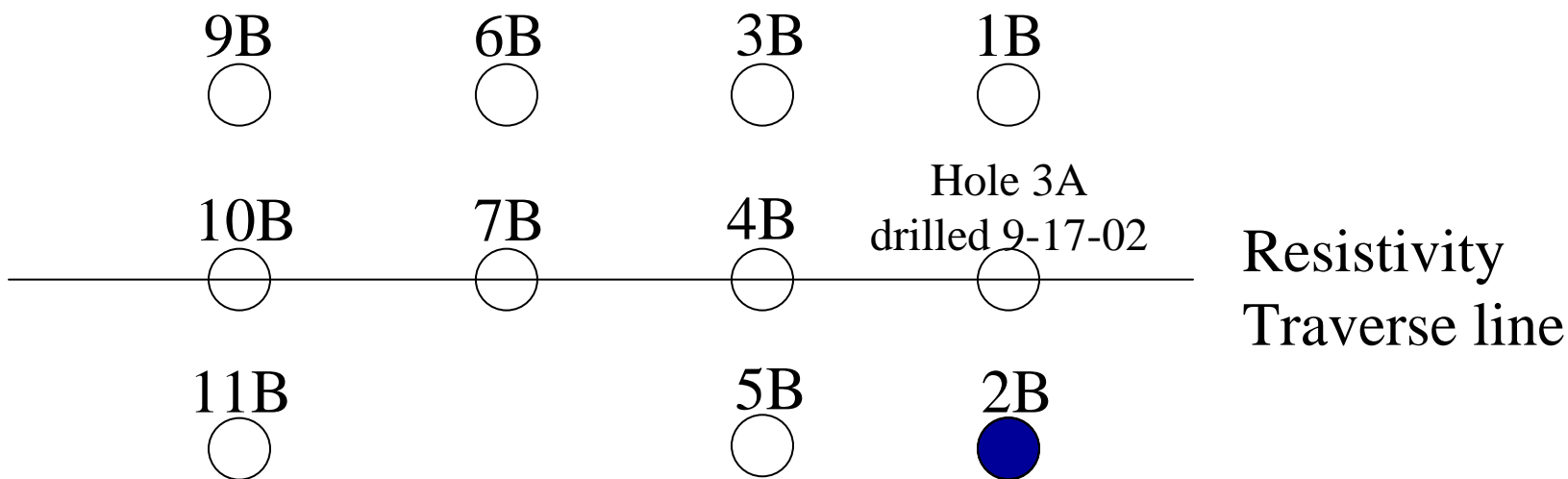
Martindale Road

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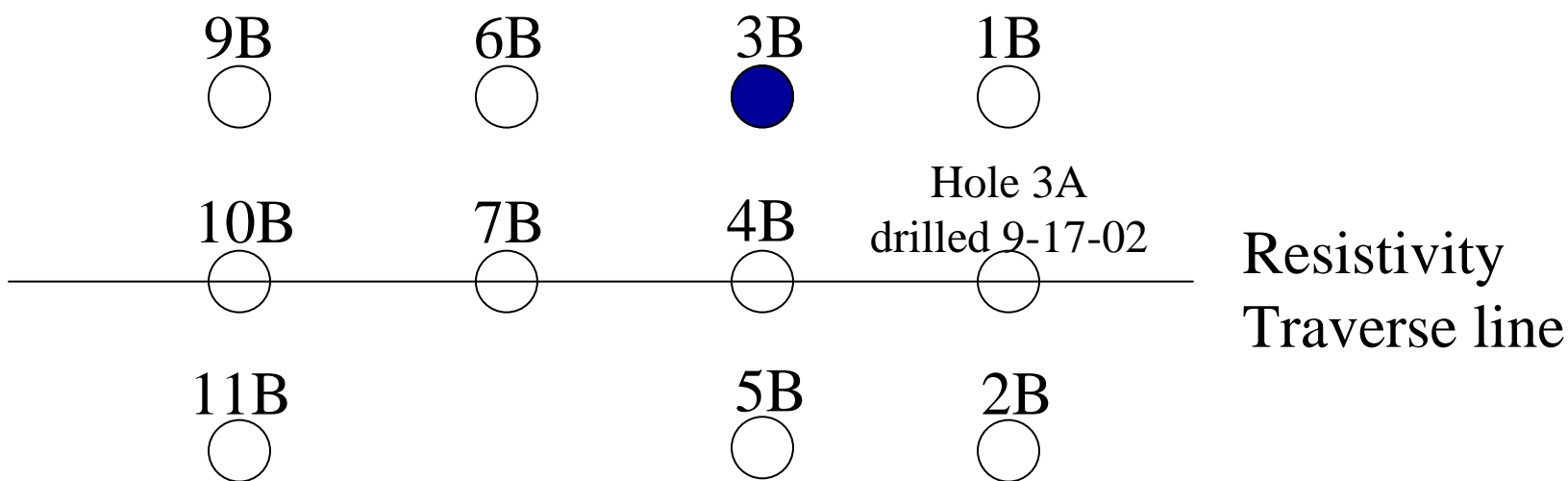
**Hole 2B – 60' deep**

0-15	dirt/clay
15-28	solid
28-30	dirt/loose
30-34	solid
34-36	broken
34-60	solid





0-13	clay
13-54	solid
54-60	open

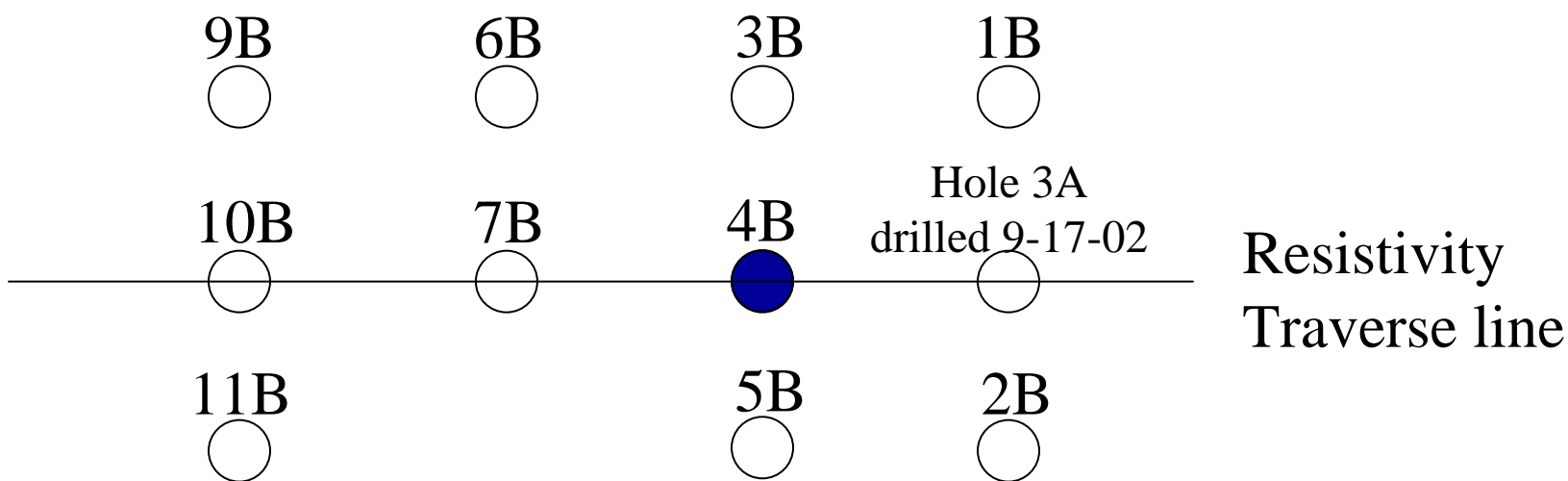


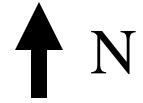
# Martindale Road



**Hole 4B – 60' deep**

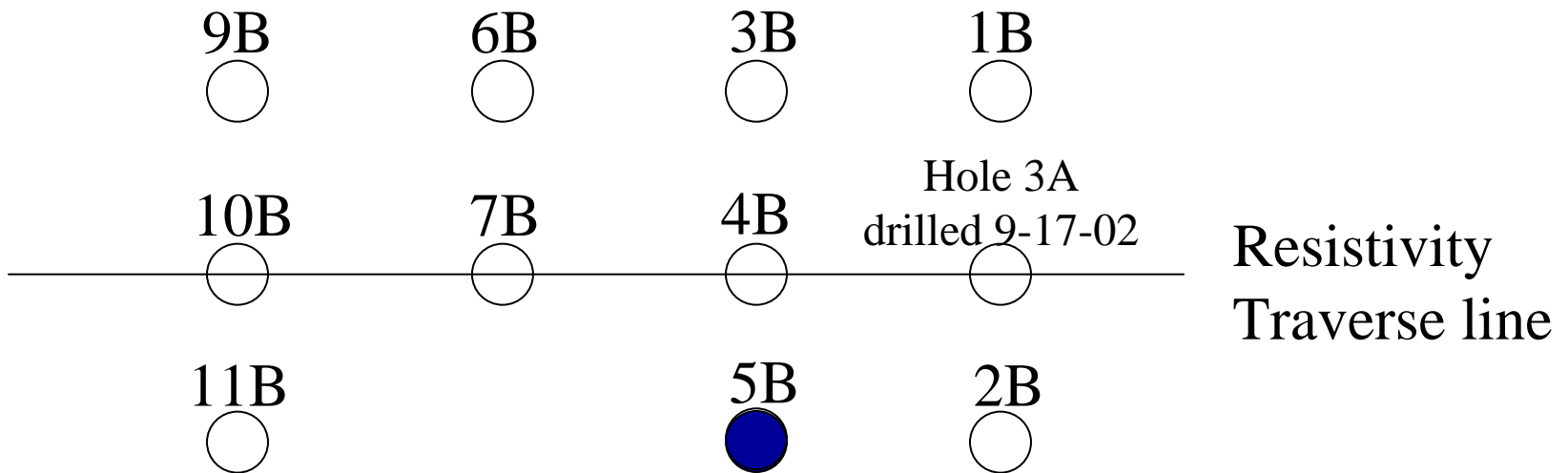
0-15	clay
15-26	solid
26-36	open
36-60	solid





**Hole 5B – 60’ deep**

0-17      clay  
17-60    solid (water at 50’)



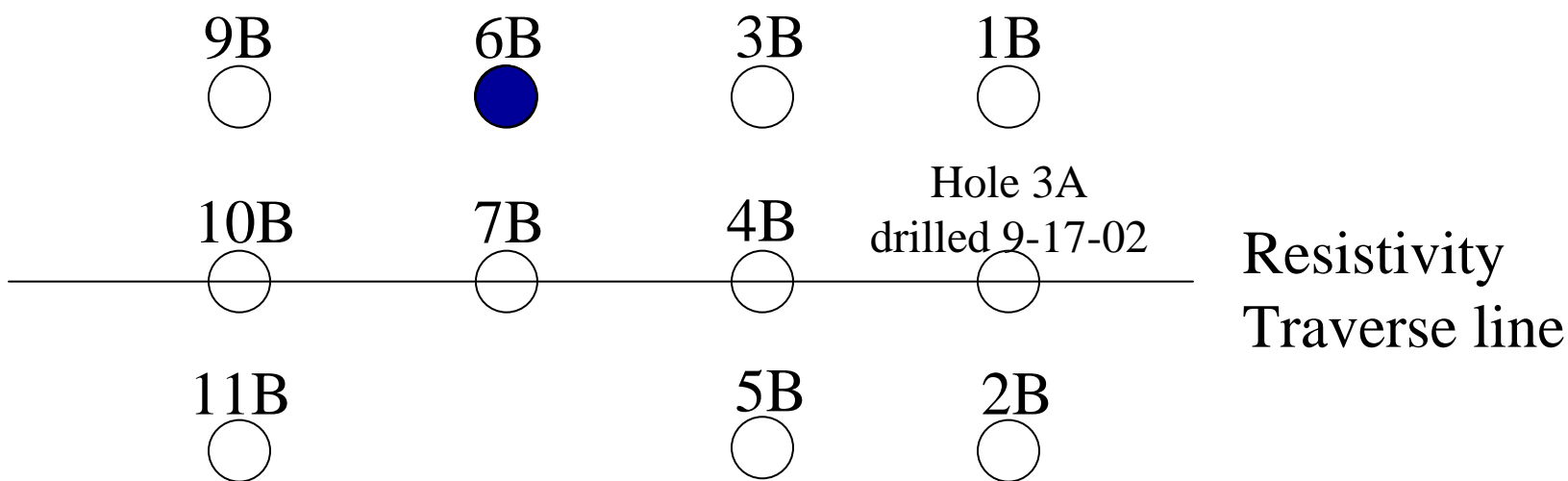
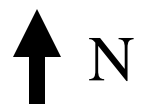
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Martindale Road

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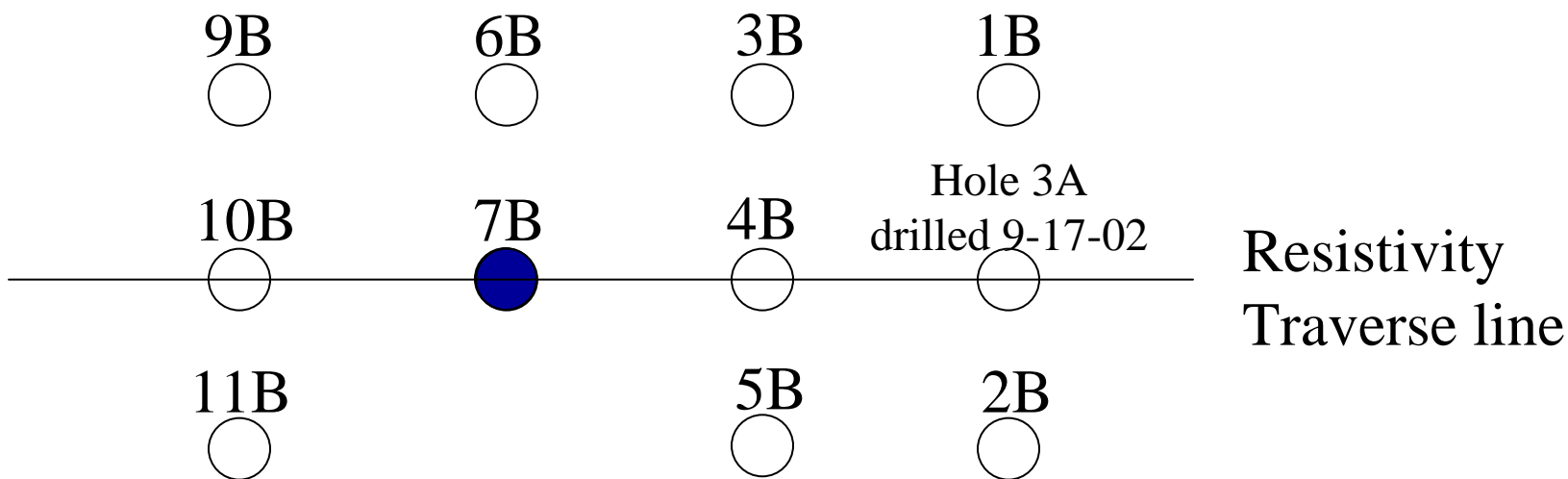
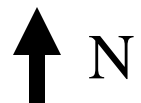
0-10	clay
10-54	solid
54-60	open



# Martindale Road

**Hole 7B – 60' deep**

0-13	clay
13-26	solid
26-36	open (water at 30')
36-60	solid

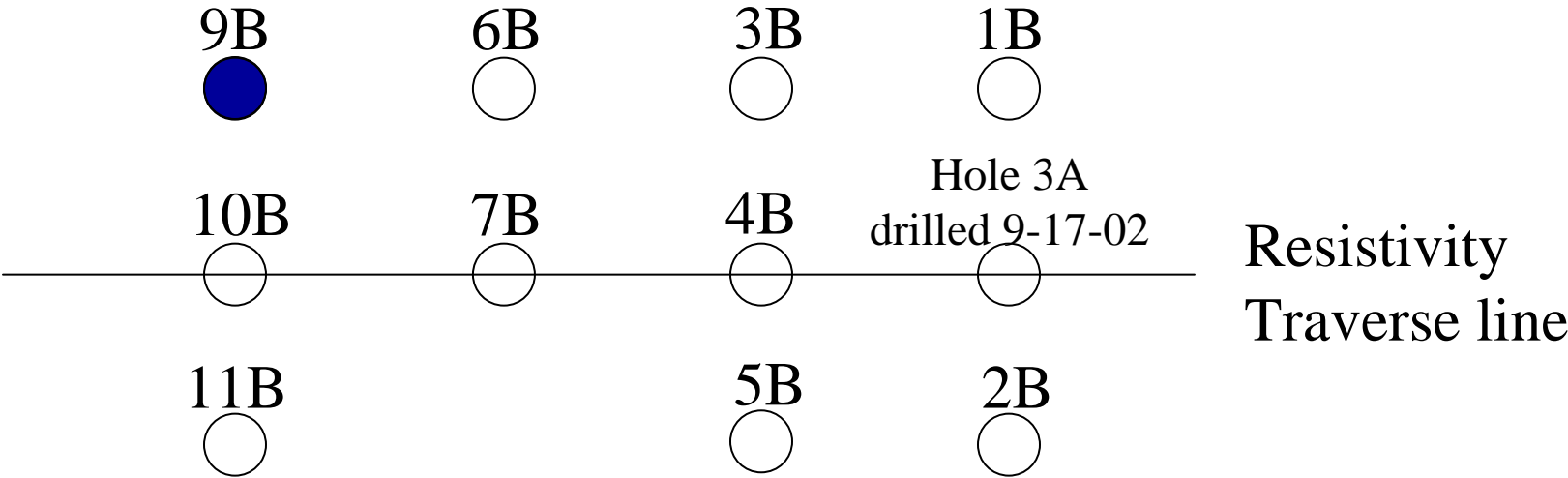
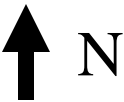


Martindale Road



**Hole 9B – 60’ deep**

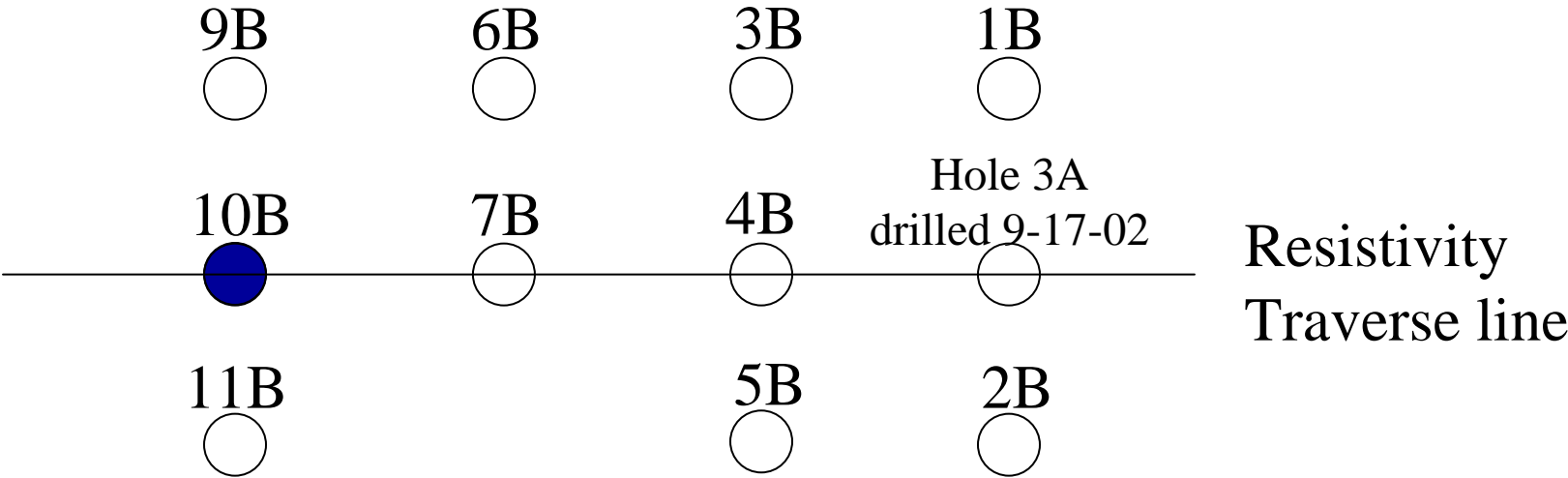
0-6      clay  
6-60     solid



Martindale Road

**Hole 10B – 60’ deep**

- 0-11      clay
- 11-30    solid (water at 30’)
- 30-39    open
- 39-60    solid

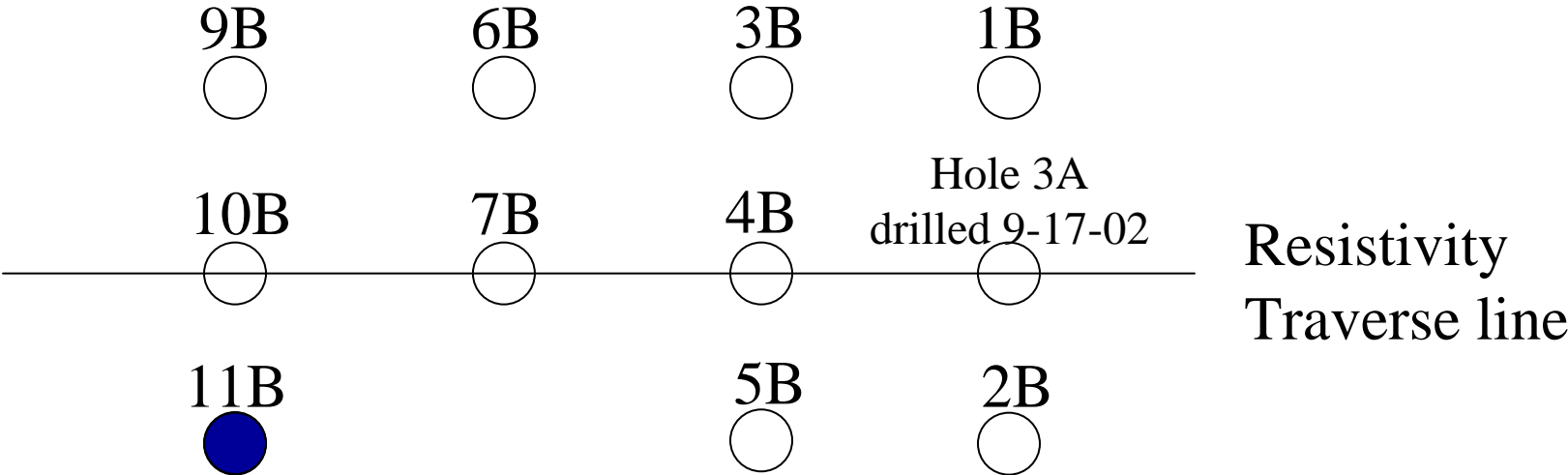
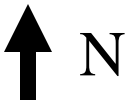


Martindale Road



**Hole 11B – 60’ deep**

0-11     clay  
11-60    solid



Martindale Road



*Used 30 yards of concrete to fill 14 holes on November 13, 2003.*





**Inverted Resistivity Section**

